Daimler Chrysler

Patent Claims

1. A method for determining a vehicle state having the method steps:

estimation of a first state in a vehicle (F) by means of a first vehicle model using predetermined parameters $(\dot{\Psi}, \ddot{\Psi}, a_y, a_x)$;

estimation of a second state of the vehicle (F) by means of a second vehicle model using the predetermined parameters $(\dot{\Psi}, \ddot{\Psi}, a_y, a_x)$;

weighted switching over from the first vehicle model to the second vehicle model at the transition of the vehicle (F) from the first state into the second state as a function of at least one estimated parameter (φ).

2. The method as claimed in claim 1, characterized in that the first vehicle model simulates movement states of the vehicle (F) by means of a first Kalman filter, and the second vehicle model simulates movement states of the vehicle (F) by means of a second Kalman filter.

3. The method as claimed in claim 1 or 2, characterized in that the first state of the vehicle stands for a rolling movement of the vehicle (F), and the second state of the vehicle stands for a tilting movement of the vehicle (F), a rolling movement describing a rotational movement about a vehicle longitudinal axis with ground contact with all the wheels, and a tilting movement corresponding to a

rotational movement which follows the rolling movement with loss of the ground contact of at least the wheels (R) of one track.

4. The method as claimed in one of the preceding claims, characterized in that, when weighted switching over from the first vehicle model to the second vehicle model occurs, the second vehicle model is initialized with parameters $(\dot{\Psi}, \ddot{\Psi}, a_y, a_x)$ of the state of the first vehicle model.

5. The method as claimed in one of the preceding claims, characterized in that the weighting for the weighted switching over is carried out as a function of an estimated angle (φ), preferably of a rolling angle or tilting angle of the vehicle (F), in particular with a rise in the weighting of the second vehicle model which is linear for increasing values of the estimated angle (φ), with a simultaneous linear drop in the weighting of the first vehicle model.

6. The method as claimed in claim 5, characterized in that the weighted switching over is carried out when the angle (φ) lies between a first predetermined angle value (φ_1) and a second predetermined angle value (φ_2), the first predetermined angle value (φ_1) preferably describing a vehicle angle at which a first, nonloaded wheel (R) of a track lifts off, and the second predetermined angle value (φ_2) describes the vehicle angle at which a second, nonloaded wheel (R) of the same track loses ground contact.

7. The method as claimed in one of the preceding claims, characterized in that, when the first state is estimated as an interference variable, a longitudinal inclination (Θ) of the carriageway, a transverse

inclination (Φ) of the carriageway, a transverse inclination rate ($\dot{\Phi}$) of the carriageway and/or a coefficient of friction (μ) of the carriageway are simulated and taken into account.

8. The method as claimed in claim 7, characterized in that the longitudinal inclination (Θ) of the carriageway and the transverse inclination rate ($\dot{\Phi}$) of the carriageway are simulated by means of a Markov process, and the coefficient of friction (μ) of the carriageway is modeled as a quasi-constant variable.

9. The method as claimed in one of the preceding claims, characterized in that, when tilting of the vehicle (F) is detected as a movement state, individual wheel brakes of the vehicle (F) are selectively activated in order to stabilize the vehicle (F).

10. The method as claimed in one of the preceding claims, characterized in that the vehicle mass (m), the position of the center of gravity (S) of the vehicle, the wheelbase, the track width and/or the rolling characteristic, in particular the rolling rigidity, and/or the damping of the vehicle are taken into account in the modeling of the vehicle.

11. The method as claimed in one of the preceding claims, characterized in that, by means of brake pressures which are made available per wheel (R) by means of the vehicle (F) as well as by means of wheel circumferential speeds which are made available, circumferential forces of individual wheels (R) are estimated, preferably by means of a deterministic Luenberger observer system, from which a vehicle longitudinal acceleration (a_x) is estimated.

12. A device for determining a vehicle state, in particular for operating a method as claimed in one of the preceding claims, having:

a first estimation device for estimating a first state of a vehicle (F) by means of a first vehicle model using predetermined parameters $(\dot{\Psi}, \ddot{\Psi}, a_y, a_x)$;

a second estimation device for estimating a second state of the vehicle (F) by means of a second vehicle model using the predetermined parameters $(\dot{\Psi}, \ddot{\Psi}, a_y, a_x)$;

a switchover device for the weighted switching over from the first vehicle model to the second vehicle model at the transition of the vehicle (F) from the first state into the second state as a function of at least one estimated parameter (φ).

13. The device as claimed in claim 12, characterized in that a yaw acceleration measuring device, a transverse acceleration measuring device and preferably a longitudinal acceleration measuring device and/or a rolling rate measuring device are provided for making available the predetermined parameters.